Volume 1

U.S. Army Corps of Engineers

Chapter 3

Engineering Evaluation/Cost Analysis
Volume 1
Former Camp Beale
Yuba and Nevada Counties, California

July 2003

Contract No. DACA87-95-D-0017
Task Order No. 0027
Project No. J09CA013601

Final

U.S. Army Corps of Engineers
U.S. Army Engineering and Support Center
4820 University Square
Huntsville, Alabama 35816-1822

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Prepared by

Earth Tech, Inc.
1461 East Cooley Drive, Suite 100
Colton, California 92324

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

LIST OF PHOTOGRAPHS

3.0 SITE CHARACTERIZATION

The Volume 1 EE/CA field investigation in Area 1-A and Area 1-B of the Former Camp Beale was initiated on 16 July 2002 and was completed on 9 August 2002. Using data collected during the Volume 1 EE/CA field investigation and data collected during the site reconnaissance phase (site visit, records searches, and analysis), a qualitative risk evaluation was performed (Chapter 4.0) to substantiate and document the most appropriate OE response actions for Area 1-A and Area 1-B. The characterization of Area 1-A and Area 1-B at the Former Camp Beale consisted of the following:

- Historical data collection and analysis
- DQO development
- Identification of high risk areas
- Geophysical mapping

Details concerning each of these tasks and the results of the Volume 1 EE/CA field investigation are discussed further in the following sections.

To develop the most appropriate OE response action alternatives for non-time-critical removal of ordnance in Areas 1-A and 1-B, it was necessary to characterize the Volume 1 areas in terms of OE risk to the public. This was accomplished by assessing the OE hazard level (i.e., likelihood for OE exposure) that may be present in each of these areas. OE exposure was derived from the extent and types of (potential) OE (including UXO) present, site characteristics (accessibility), and human factors (activities and population).

The extent of OE in an area is typically determined by searching a statistically significant and representative portion of the site for OE. Visual and geophysical surveys are performed to detect and map locations of subsurface anomalies caused by buried objects that could be OE. Generally, these identified locations are then intrusively explored to determine the sources of the anomalies. For purposes of this Volume 1 EE/CA, intrusive investigation of these anomaly sources was not performed; rather, all of the subsurface anomaly sources were assumed to be potential OE for cost estimating purposes and for determining the potential OE hazard level (i.e., potential OE risk) to the public. Among the anomalies, a wide range of sources are possible besides potential OE (wire, posts, horseshoes, etc.).

Site characterization efforts during the Volume 1 EE/CA field investigation were focused on areas that pose the highest potential risk to public safety based on evaluation and analysis of historical data, ASRs, and prior investigations or location of OE/UXO-related findings during the historical data collection and analysis process.

During the Volume 1 EE/CA field investigation, UXO technicians serving as safety escorts accompanied all survey and geophysical mapping crews. The UXO technicians performed visual surface surveys, conducted en route, and magnetometer surveys at locations where vegetation restricted visual sight of the ground surface.

3.1 HISTORICAL DATA COLLECTION AND ANALYSIS

A number of data sources were evaluated to collect and categorize data regarding military activities, OE, and potential OE exposure at the Former Camp Beale. Data sources included historical record searches and analyses of documents pertaining to ordnance previously recovered on the project site, land uses or activities, and site characteristics. Data sources included, but were not limited to:

- ASRs
- Aerial photography (historical and current)
- Topographical maps
- Range maps
- Site Prioritization Report
- Soil survey studies
- Census data (1995)
- County general plans
- Summaries of interviews/public meetings
- Records of responses by Sheriffs' Departments
- EOD Reports (Beale and Moffett Field).

3.2 DATA QUALITY OBJECTIVES

The DQOs listed hereafter were developed during the Technical Project Planning (TPP) process and included participation by project and technical managers from CESPK, CEHNC, Department of Toxic Substances Control (DTSC), and various contractors involved in this project. These DQOs are qualitative and quantitative statements that establish the minimum data requirements to be used as the basis for the decision making process for determining the areas that pose the highest OE hazard to the public at the Former Camp Beale. These DQOs were established using the processes outlined in the Technical Project Planning Process (TPP) (EM200-1-2) and data quality process for superfund workbook (EPA540-R93-078, PB94-963204).

3.2.1 Data Collection

Data was extracted and categorized from the sources listed above into four criteria objectives:

- Greater population density (land use)
- Known OE ranges
- Known OE findings
- Identifiable range boundaries.

These criteria objectives were developed as DQOs for selection and recommendation of areas within the project site for a clearance action with minimal field study.

3.2.2 Data Quality Objectives

The following DQOs were developed to ensure that sufficient quantities and quality of information were collected and analyzed to identify areas that can be recommended for a clearance action. As discussed in Chapter 2.0 and illustrated in Figures 2-1 through 2-4 (Chapter 2.0), historical records depicted numerous areas that may have been used for OE-related activities on the Former Camp Beale project site. The DQOs presented below were designed to identify the areas that present the highest OE hazard to public safety.

3.2.2.1 Greater Population Density (Land Use).

- The area must have been zoned for residential use and must have residents on or in close proximity to the area.

This DQO relates to the number of exposures that can be expected due to residents or visitors in a given area. Data were collected by reviewing and analyzing aerial photography and observations made during numerous visits to the site in areas where historical OE/UXO findings have been reported.

3.2.2.2 Known OE Ranges.

- The area must be inside or in close proximity to OE ranges used by DOD.

This DQO relates to locations of ranges that have been identified and verified in historical records or recent studies. Data evaluated included:

- ASRs (ASR Report 1 and 2)
- Aerial photography
- Site Prioritization Report
- Interviews.

3.2.2.3 Known OE Findings.

- The area must have reported incidents of OE, fragmentation, craters, or other OE evidence.

This DQO relates to reports or evidence of OE that indicated and validated the presence of OE. Data that was evaluated included:

- Summaries of interviews/public meetings
- EOD Reports (Beale and Moffett Field)
- Records of responses by local Sheriffs' departments
- Previous investigations/clearances
- Items noted on surface during field investigations.

3.2.2.4 Identifiable Range Boundaries.

- The area recommended for a clearance action must possess boundaries that can be reasonably identified and defined.

This DQO relates to the boundaries that must be identified through a process of consolidating all of the data accumulated by the previous DQOs and by defining the areas that present the greatest potential for exposure to OE. Ground disturbance boundaries identified in the historical aerial photography analysis served as a major qualifier for identifying range boundaries, whereas areas that displayed ground disturbances from historical DOD activities and were not reduced by one of the other DQOs were added to the Volume 1 areas. Geophysical investigation data were collected to verify subsurface anomalies (potential OE) within Areas 1-A and 1-B. Additional data that was evaluated included:

- Topographical maps
- Range maps
- Aerial photography
- Interviews
- Historical maps (ASR 1 and 2).

3.3 SELECTION AND DESCRIPTION OF VOLUME 1 AREAS

Based on the requirements of the DQOs and the results of a historical records analysis, two areas (Area 1-A and Area 1-B) were identified as areas within the Former Camp Beale that pose the highest risk to public safety. The basic area selection process (using the DQOs) is illustrated in Table 3-1. Area 2 and Area 3 represent the Area 5 that will be investigated in Volume 2 and Volume 3, respectively. The Volume 1 sites were further studied by geophysical methods to validate data collected in the historical records analysis and to collect data on the distribution (patterns) and density (extent) of potential OE on those sites. A brief description of each area and analysis of data required by the DQOs is discussed below.

Table 3-1. Volume 1 DQOs and Areas that Meet the DQOs

Data Quality Objectives Volume 1	Area 1-A	Area 1-B	Volume 2	Volume 3
1. Greater Population Density (Land Use)	Yes	Yes	Yes	Yes
2. Known OE Ranges	Yes	Yes	No	Yes
3. Known OE Findings[(a)(b)]	Yes	Yes	No	No
4. Identifiable Range Boundaries	Yes	Yes	No	Yes

Notes: (a) OE findings recorded
(b) A number of OE-related findings in Volume 3 areas were located beside roads or in a horse trough, indicating they had been placed there with the original location unknown.
OE = ordnance and explosives

The two areas (Area 1-A and Area 1-B) of the Volume 1 EE/CA field investigation are areas within the Former Camp Beale that have a greater population density, known OE ranges, known OE findings and identifiable range boundaries. Further details for each area are listed below and discussed in the CSM provided as Appendix B.

3.3.1 Area 1-A (Camp Far West)

Area 1-A, in Camp Far West, comprises approximately 2,131 acres in the southwest corner of the Former Camp Beale. This area was used by the military and contains or is overlapped by Bombing Target No. 1; Bombing Night Target No. 1; Moving Target Range No. 9; Ground Ranges No. 6, 11, and 12; and Mortar Range No. 13. Photographic analyses from 1943-1944, 1947, 1953, 1958, and 1962 revealed extensive ground disturbances that are associated to historical DOD activities and may have been created during previous OE-related activities. OE has been recovered in and around this area by local agencies and Beale AFB EOD. Residential development has occurred and is continuing to occur in this area, which has increased the potential for exposure to OE.

3.3.2 Area 1-B (Big Oak Valley)

Area 1-B in the Big Oak Valley area comprises approximately 94 acres in the north-central region of the Former Camp Beale. This area was used by the military and encompasses most of the Tank Range #12 site and is overlapped by Combat Course Range 24, Infiltration Range 100, and Ground Ranges 7, 11, and 13. Photographic analyses from 1943-1944, 1947, 1953, 1958, and 1962 revealed extensive ground disturbances that are associated to historical DOD activities and may have been created during previous OE-related activities. OE has been recovered in and around this area by local agencies and Beale AFB EOD. Residential development has occurred in this area, which has increased the potential for exposure to OE.

3.4 GEOPHYSICAL MAPPING

From 17 July 2002 to 5 August 2002, Zonge Engineering and Research Organization (Zonge) of Tucson, Arizona, deployed two geophysical mapping teams to collect data for the Volume 1 EE/CA. The teams consisted of two persons each with oversight provided by a senior geophysicist, who also provided on-site data processing.

Approximately 37 acres, comprised of some 93 linear miles of path, were geophysically mapped in two areas (Area 1-A and Area 1-B) using TEM arrays (Photographs 3-1, 3-2, 3-3, and 3-4). The specific survey parameters were determined from the Technology Evaluation results (available at local repositories or the Former Camp Beale internet site). Random geophysical transect paths were planned (per the EE/CA Volume 1 Work Plan) to facilitate avoidance of sensitive natural and cultural resources, as well as avoidance of natural barriers and surface OE hazards. Plate 3-1 and Plate 3-2 (located at the end of Chapter 3.0) show the geophysical transects mapped throughout the various investigated

Photograph 3-1. Geophysical mapping crew setting up equipment.

Photograph 3-2. Geophysical mapping team checking GPS mounted on an EM-61 Mk2 prior to performing a random transect.

Photograph 3-3. Geophysical mapping team performing random transect throughout a parcel.

Photograph 3-4. Geophysical mapping team performing random transect throughout a parcel.

parcels in Area 1-A and Area 1-B during the Volume 1 EE/CA field investigation at the Former Camp Beale.

The geophysical data were analyzed, and the results of the analysis were used to identify the locations of significant subsurface anomalies (i.e., those with the potential to be OE items). Navigation and instrument position within the investigation area were tracked and recorded using precision surveying with state-of-the-art differentially corrected global positioning system (DGPS) instrumentation. The North American Datum of 1983 (NAD83) State Plane Coordinates, California, Zone II, U.S. Survey Feet, was used for DGPS references.

The geophysical investigation was conducted under the direction of Earth Tech's project geophysicist who monitored the data collection and reduction processes used and was responsible for reviewing the field data to assure complete coverage, measurement precision, representativeness, and geophysical reasonableness of the survey results.

3.4.1 Methodology and Instrumentation

TEM and magnetometer systems were evaluated during the EE/CA Technology Evaluation conducted January 2002 and as documented in the Technology Evaluation report dated June 2002 to determine the best detection methodology to be deployed at the Former Camp Beale. The Technology Evaluation Report for the Former Camp Beale is available at the various information repositories: Yuba County Library, Nevada County Library, and Beale AFB Library, and at the official Former Camp Beale web site at http://www.campbeale.spk.usace.army.mil. Based on the results of the Technology Evaluation Report, availability of equipment at the time of the EE/CA investigation and costs, the Geonics EM-61 Mk2 Version was selected for use during the Volume 1 EE/CA field investigation.

TEM refers to the way in which the instrument records the response measurement (timed) to follow the transmission of an EM pulse. Highly conductive objects (metal) retain electrical current longer than soil materials. The time interval during which the measurements are taken is that which best shows the persisting signal from the highly conductive target and misses the early, fast-diminishing returns from soil. A more thorough discussion of the operation and functioning of the EM-61 is provided in the Technology Evaluation Report.

Anomaly discrimination was accomplished using a proprietary software program "EM61INV" developed by Zonge to identify discrete peaks above background response levels caused by metallic sources buried in the near surface (or twin peaks in the case of sources that are much smaller than the EM-61 antenna widths).

3.4.2 Performance Criteria

Coverage of the transects, detection performance, and reasonableness of the geophysical data were assured by observation of field techniques and review of the collected data. Data were checked for completeness and reasonableness using field notes, field maps, GeoSoft Software OASIS MONTAJ™, and Golden Software SURFER™. QC processing of digital data included production of selected profiles that were used to compare visually discriminated locations with those anomaly locations identified by the color contour image. Quality control tests with each deployed TEM and GPS system over known sources and established positions demonstrated good repeatability of both TEM response and real-time kinematic (RTK) GPS positioning. Standardization tests were conducted whenever the TEM systems were initiated and before they were shut down. All data performance criteria, as outlined in the *Final Engineering Evaluation/Cost Analysis Work Plan (Volume 1), Former Camp Beale, Yuba and Nevada Counties, California* (Earth Tech 2001a), were met.

3.4.3 Survey Layout

Zonge set up and established a GPS base station for Area 1-A over the Sutter Water District (SWD) survey control point used to collect data during the previously completed technology evaluation field effort (39 03 minute [‘] 44.3148 second [“] North and 121 18’ 29.6077” West [WGS84]). Zonge personnel established two reference locations, each marked with rebar, to be used as positional checks of GPS precision and for daily system latency and position checks. Each system was passed over the references at the start of each survey day in Area 1-A and again at the end of the day.

The control point was recovered using a Schonstedt GA-52CX (the station marker, pipe in ground on hilltop adjacent to the SWD test plot, was overgrown and not visible). The survey teams tested complete functioning of each system (EM61Mk2/Leica RTK GPS) configured for production detection and mapping. Multiple standardization tests (eight) were performed throughout the first day to establish baseline standard values for each system.

For positional control in Area 1-B, a GPS base station (2190675.42, 6766438.56) was established in Parcel # 50-200-010 by occupying the point with the GPS and recording a static position relative to an NGS benchmark. The NGS benchmark, PID KS2015 (horizontal Order A control point), is situated approximately 200 feet south of intersection of Highway 20 and Smartville Road (2200176.92, 6763655.52). The backshot from the Area 1-B base station to the benchmark control point, KS2015, to check accuracy coordinate was 1.0 foot off in the horizontal direction (see Figure 3-1). New latency stakes/position check points (points lat3 and lat4), also on parcel 50-200-010, were established for QC checks.

A “drive-around” test was performed to assess which parcel areas would potentially have RTK dropout or shadowing problems during the geophysical mapping effort because terrain features (topography and trees) were a concern for GPS base station to rover telemetry. The test established that very few complete parcels could be surveyed without additional equipment. A 35-watt radio repeater was obtained to increase the RTK signal range from the SWD base. Additionally, on 23 July 2002, a new GPS base was established in Area 1-A at top of hill in Parcel 15-380-092 (named “Base92”). This point was occupied for 20 minutes to obtain an adequate RTK average position. The

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 3-1

THIS PAGE INTENTIONALLY LEFT BLANK

Base 92 position was rechecked by the second GPS rover system, which recorded a position less than 0.1-foot different from the first team's solution for the point.

3.4.4 Field Data Collection

Digital geophysical measurements were collected along random transects beginning on 17 July 2002 and lasted through 5 August 2002. Table I of the Volume 1 Geophysical Investigation Report (Appendix C) shows the total number of miles mapped (via random transects) in each parcel during the Volume I EE/CA field investigation.

The geophysical data were collected using the Geonics, Ltd., EM-61 Mk2 metal detector with a Leica SR530 RTK GPS mounted centered at the trailing edge of the Mk2 antennas. Geophysical and GPS data were simultaneously captured electronically in an Allegro field computer. A Pacific Crest radio transmitter was used to establish the GPS correcting base station data radio link to the roving GPS units.

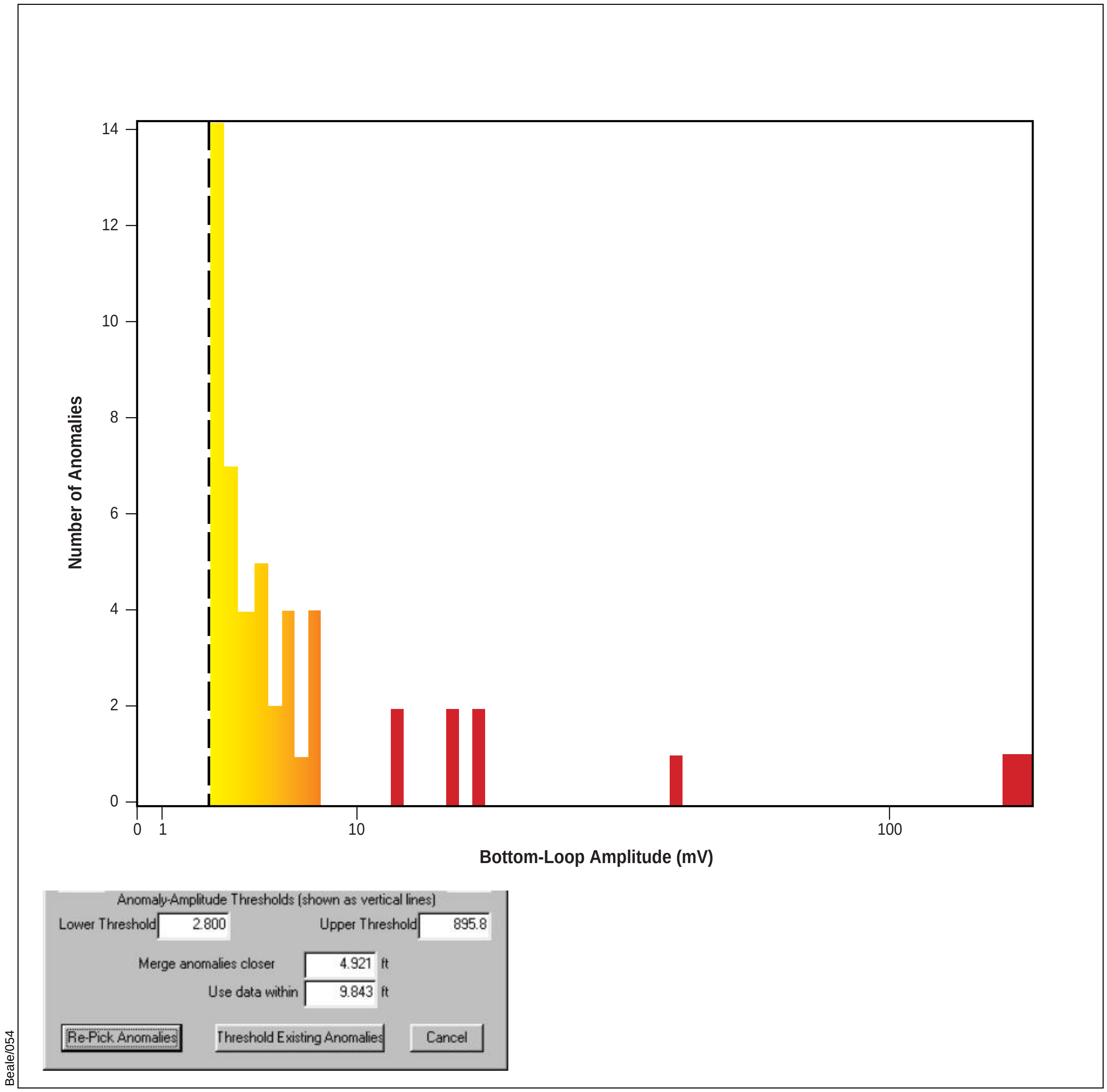
At the beginning of data collection of field activities, discrepancies were noted between the aerial photograph and the physical inspections of parcel boundaries. The original parcel boundary was not correct. As a result, mapped data illustrating the original parcel boundaries in the Zonge Report (Appendix C) appear to extend beyond the parcel boundaries. During data collection, individual landowners were asked to identify boundaries. Once field activities were completed, the parcel boundaries were rectified based on aerial photographs and information from individual landowners. Plates 3-1 through 3-4 have been updated to include the corrected parcel boundaries.

The EM instrument sampling rate was ten readings per second; a time stamp was recorded for each record. DGPS data were collected at two positions per second. Data coordinates were determined by interpolating GPS coordinates and time-stamped geophysical response. This was accomplished using downloaded data stream and user interfaces written for EM-61 and Leica SR530 RTK GPS data by Zonge. The equipment was mounted on wheels and man-towed at a slow walking pace (approximately 2 to 3 feet per second).

The geophysical teams each maintained a daily log that detailed pertinent activities, survey lane features, and field conditions encountered in the performance of the geophysical investigation. A field sketch map of surveyed areas was generated for each parcel mapped.

3.4.5 Field Data Analysis

The TEM data were analyzed using automated picking algorithms developed by Zonge. The program generates a histogram to be used in identifying model responses in the data and to determine threshold criteria for each individual profile (Figure 3-2). A spheroidal model is calculated for the threshold peaks. Those anomalies with good fits to the calculated model were identified as potential OE targets. An example anomaly plot is presented in Figure 3-3.

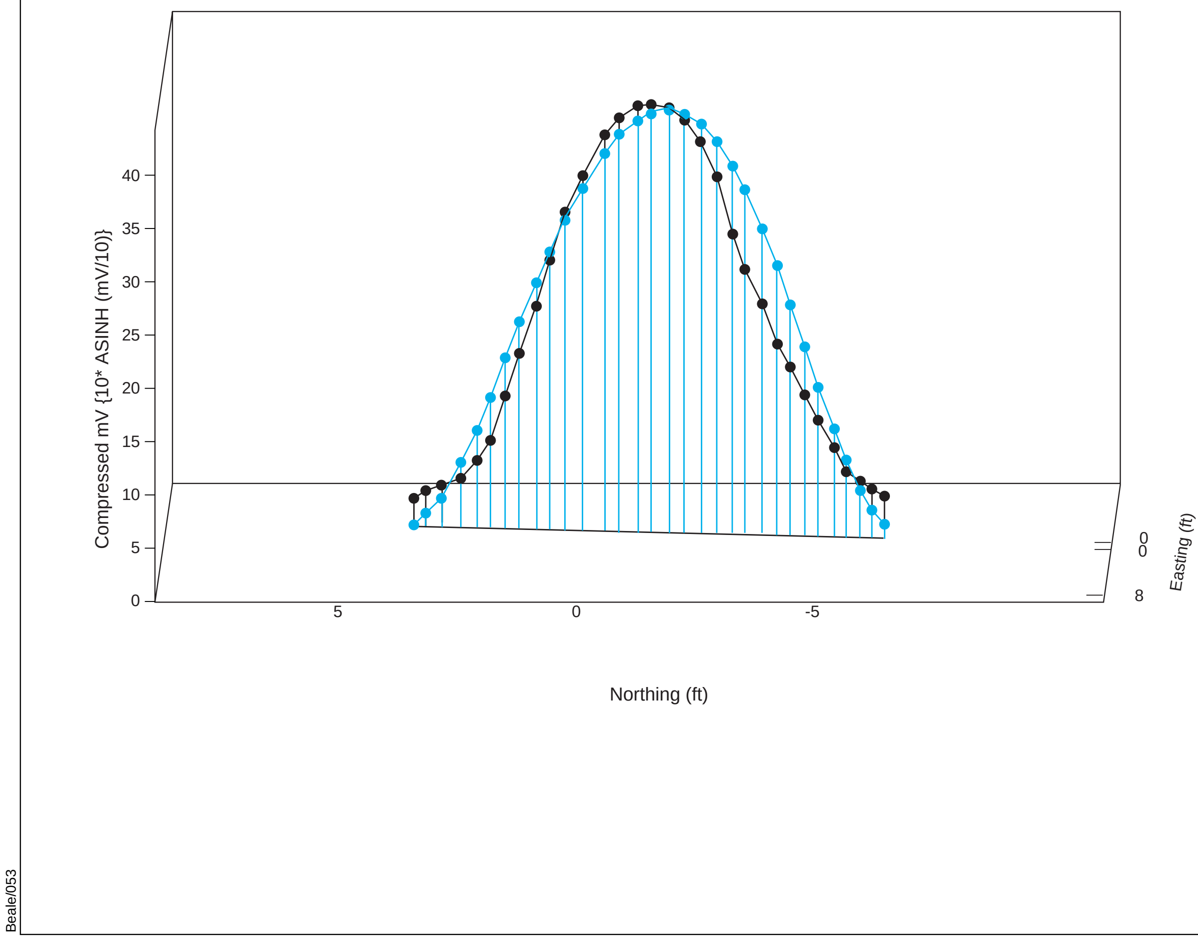


EXPLANATION

Anomaly Amplitude Thresholds

Example Anomaly Lower and Upper Thresholds

Figure 3-2



EXPLANATION

- ● Measured Data
- ● Modeled Data
- **mV** milliVolt
- **H** Magnetic Field Strength

Example Geophysical Anomaly Profile Plot

Figure 3-3

TEM and GPS data were dumped from the data loggers to a laptop personal computer (PC) daily. Downloaded TEM data were in a block American Standard Code for Information Interchange (ASCII) format. GPS coordinates were saved into a tabular spreadsheet file with comma-separated values. Zonge data processing software merged the two data sets by interpolating GPS coordinates to TEM measurement position by referencing the time stamp (recorded as decimal hours). The merged data set presents northing and easting, top coil response (millivolt [mV]), bottom coil response (mV), a filtered response, and the mathematical difference between the top and bottom coil response in a single electronic file.

Anomaly widths are controlled by both anomaly source dimensions and depth below ground surface (bgs), where peak width over a compact conductive object is proportional to the object depth bgs. Positive amplitude peaks coherent across several data points and differentiable from background TEM response are discriminated as anomalous responses that may be representative of discrete metallic conductors buried in the near-surface soils. The response to geologic background was suppressed with a non-linear filter by smoothing the slowly varying response to geology. The result saves narrow, closed “spikes” of the late-time response to metallic objects.

Project geophysical staff screened potential anomalies. Anomalies were individually inspected and compared with field notes. Anomalies clearly associated with linear or cultural clutter were discarded. Those anomalies with characteristic response shapes distinguishable from associated background responses were also selected for investigation. The amplitudes for these anomalies ranged from 3 mV to 30 mV.

An ASCII-format tabulation of the anomalies was generated. The table included: anomaly number, northing and easting (California State Plane [CSP] coordinates measured in feet), anomaly amplitude, and other anomaly attributes (i.e., estimated depth). A total of 3,875 anomalies were identified in the data. Plate 3-3 and Plate 3-4 (located at the end of Chapter 3.0) show the anomalies detected in Area 1-A and Area 1-B as a result of processing of the geophysical data collected during the Volume 1 EE/CA field investigation at the Former Camp Beale. Appendix D provides a summary list of all anomaly locations in Area 1-A and Area 1-B.

3.4.6 Quality Control Summary

The QC results of the geophysical survey were tracked on a master spreadsheet that tabulates survey area identification, coordinates, and date surveyed. A weekly QC summary was prepared and submitted to the CEHNC Project Manager and to CESPK.

Data sets were audited by processing data from randomly selected transects. QC processing of digital data included production of histograms and profiles for selected data or target lists. A symbol posting of the measurement stations along the survey paths was plotted to assess coverage within the parcel mapped. The images were used as a QC tool to compare visually discriminated locations with those anomaly locations identified by the automated (digital) target picking routines used to generate the anomaly lists.

A summary inspection of data plotted relative to time was performed to identify single-point anomalies, steps in response, or incoherent signal/excessive noise bandwidth. An example copy of the QC tracking log used for the Volume 1 data review and evaluation is attached. All items, except histograms and profiles, were checked for each data set. Data and target histograms and profiles were generated for randomly selected sorties.

QC checks comprised the following activities:

- Review of daily field QC documentation (e.g., maps, field notes)
- Review of standardization results (instrument precision)
- Derivation of data statistics and measurement coordinates (locational accuracy)
- Data posting for each segment (survey/coverage completeness)
- Comparison of field anomaly maps (detection performance).

Digital data was archived to document the geophysical investigation including: thoroughness of the survey, detection efficiency, and locations of identified anomalies; provide a means of quantifying the confidence that can be applied to the EE/CA results; and preserve and document the extent, precision, accuracy, and quality of the geophysical investigation. Geophysical data was transmitted to the CEHNC server and to CESPK upon completion of the field activities.

Precision. To ensure that the geophysical responses to buried sources are properly considered for OE sampling, it was necessary that a threshold or other target-characteristic criteria be recognized in the geophysical instrument response. For these criteria to be effective, the instrumentation must produce like responses to similar target sources each time the same source and receiver geometry is encountered. Daily documentation of the standardization responses within a set acceptance range was required for each sensor system deployed.

Proper operation and function of the instruments used were checked and documented in the field log each day by a standardization process prior to initiation of the day's geophysical surveys. The first days on site for geophysical personnel were used to establish baseline responses and standardization acceptance ranges for each mapping system deployed.

For standardization, Zonge used a trailer hitch ball mounted on a plywood template that ensured precise repositioning of the ball each time it was used. The Standard Response was determined by averaging the standardization measurements recorded during the first week of surveys. Standardization results were well within the tolerances specified in the Final Work Plan (90 percent to 100 percent of the standard response). Standardization procedures and standard response (for each system) were established before any geophysical mapping of the transects is performed.

Static background readings were collected for at least 180 seconds at the frequency that data will be (or were) collected. The standard target was inserted and target data were recorded for 180 seconds at the used operating frequency. The difference between target and background provides the residual anomaly response. Multiple anomaly-versus-background measurements were made to allow computation of a mean residual (anomaly response) and calculation of a standard deviation specific to the system.

The repeatability for each TEM system was separately recorded and remained within a specified value or the standard response obtained at the test plot. Repeatability for the GPS systems was plus or minus 1.0 foot or less.

Accuracy. Latency tests recorded by the Zonge field teams showed instrument drift over time. This drift in the system response time was on the order of 0.1 seconds over the course of a mapping sortie (5 to 6 hours). At survey speeds of 3 to 4 feet per second, the drift impact is negligible and no corrective actions were sought.

Completeness. Geophysical mapping tracks were plotted over field maps to check for complete coverage of investigation areas. The crew working in Parcels 15-380-125, -126, -127, and -128 (contiguous parcels without fences in between, and property owners not in residence) had trouble maintaining reference data radio link (intermittently lost RTK) near center of these parcels prior to setting up the repeater station. A poor satellite configuration window occurred between 1330 to 1500 local time on the first 2 days of mapping. The window shifted earlier by about 10 minutes each successive day. Crews planned lunch/breaks and possible project manager QC checks at the command post during this window, to maximize productivity. Once satellites were adequately arrayed, the teams worked through the afternoon. Unavoidable obstacles were identified in field notes and resulted in direct correspondence with missing data.

The field teams did experience occasional GPS dropouts, as evidenced in their data and observation of “fits and starts” progression over some transects. These had no significant impact because the survey objective was to obtain a total of 88-plus random miles of survey; continuous survey transects were not a requirement. Data coverage within the investigation areas exceeded the minimum requirements (some 93 linear miles of transect were recorded). Transect distribution within each parcel was adequate. No data were collected within 200 feet of habitable structures or roadways (this did result in some unavoidable “open” spaces in the parcels).

Reasonableness. Variations or results not compatible with prior results or expectations were reviewed with the subcontractor geophysicist to determine causative features that may be present. The field teams mapped near proximity to fence lines on a few occasions during the first few days of the survey. Transects that paralleled fences exhibit data peaks that appear to be equally distant in space and are likely caused by metal fence posts. To preclude additional fence interference problems with the data, field teams were asked to maintain at least a 20 to 30 foot separation between the EM-61 Mk2s and fence lines.

Targets were picked using the 660 millisecond (ms) time window of the Mk2 (channel 3) that was used to identify targets during the equipment evaluation. It appears that use of the earlier time windows may highlight anomalies not identified at 660 ms. However, there were also targets selected at 660 ms that were not of interest at the earlier time gates. This suggests final target picks (prior to intrusive investigation) should be extracted from two or more windows in the data response curves, or perhaps from an algorithm that utilizes two windows to enhance identification of anomalies.

3.5 SOURCE, NATURE, AND EXTENT OF ORDNANCE AND EXPLOSIVES

3.5.1 Summary of Historical Data Analysis

Based on data reviewed from the many sources available on the Former Camp Beale, including the CSM developed by CESPK (Appendix B), OE-related training by DOD has occurred in the Volume 1 areas (Area 1-A and Area 1-B).

Bombing targets, moving vehicle and moving target ranges, a mortar range, and several ground ranges overlap most of Area 1-A. Likewise, a tank range, combat course, infiltration course training area, and several ground ranges overlap Area 1-B. Ground disturbances that coincide with potential target areas are indicated in the historical series of aerial photography and evidence on the ground indicated during the site prioritization site visit (Zapata, 1999), previous surface removal actions, and the Volume 1 geophysical investigation, strongly support the potential for OE in the subsurface soils.

3.5.2 Summary of Results of Volume 1 EE/CA Field Investigation

The following ordnance-related items were sighted or recovered during the Volume 1 EE/CA field investigation:

- APN 15-380-124: OE related metal scrap
- APN 15-160-091: Projectile fragment (possible 57mm/75mm)
- APN 15-380-030: Mortar fragment (possible 60mm/81mm)
- APN 15-380-032: Multiple craters
- APN 15-380-092: Partial mortar fin assembly
- APN 15-040-045: Multiple craters
- APN 15-380-108: Inert M1 landmine (turned over to CESPK)
- APN 15-380-148: Multiple craters

- APN 15-380-149: Projectile fragment (possible 57mm/75mm)
- APN 15-160-052: Shrapnel, OE scrap and craters throughout parcel
- APN 15-380-028: Multiple craters
- Camp Far West Road adjacent APN 15-380-030: Shrapnel
- Earthen-covered bunkers were noted in a parcel adjacent to APN 15-160-075 while transiting an access road.

The parcels where OE-related items were sighted during the Volume 1 geophysical investigation are illustrated on Plate 3-3 and Plate 3-4 (located at the end of Chapter 3.0).

3.6 FORMER CAMP BEALE VOLUME 1 OPERABLE UNIT (OU) DESIGNATION AND DESCRIPTIONS

Operable Units (OUs) are sub-set areas of a larger area, such as a sector, that have been assigned control boundaries (e.g., OU boundary) for the purpose of planning and prioritizing response action activities. OU delineation helps ensure an incremental process towards comprehensively addressing OE problems within the OU and site. The criteria for an OU is based on site-specific information or data that will be listed with the description and procedures used to delineate each OU.

In order to plan and prioritize response actions within Volume 1, and due to its overall size and complexity, Volume 1 has been organized into smaller, relatively similar, OUs. The OUs (OU-1 through OU-7) are presented on Plate 3-5. Each of these OUs possesses access routes that provide direct access to all of the parcels contained in the OU.

The procedures discussed in the following paragraphs were used to delineate and designate each operable unit and were based on generally accepted criteria for sectorization protocol. In compliance with the goals of the Former Camp Beale Strategy Plan, efforts were taken to consider units of property or area in terms of “parcels” to facilitate consistentcy in regards to scheduling and production on any particular landowners property. Under this goal, parcel boundaries were used as the overriding criteria for delineating the ultimate boundary of a particular operable unit. The following criteria or input were used in determining the delineation of an operable unit:

1. Former DOD Use (Targets, Ranges, Historical Photo Analysis, etc.)
2. Anticipated OE Type
3. Anticipated OE Distribution
4. Current and Future Land Use

5. Access (Terrain, Roads)

6. Cultural/Natural Features

7. Other Applicable CSM Features.

Each range or target area (both known and suspected) identified by the CSM or ASRs was characterized based on the aforementioned criteria with an emphasis on the historical disturbances that were associated with each of those ranges or targets. Where positive correlation of targets versus historical disturbances could be identified, an OU was developed to enclose that particular target area (such as Bombing Target #1 and the disturbed area immediately overlaying the target). Where positive correlation between specific targets/ranges and historical disturbances could not be identified, a broader criteria was used to develop the OU (such as OU-4, which has more than one target associated with multiple ranges). Where possible, roads were utilized to identify portions of OU boundaries to facilitate easier geographical identification of boundaries by field personnel during removal activities.

The following paragraphs provide a description and details for the development of each operable unit within Volume 1:

- **OU-1:** This OU consists of the area identified as Moving Target Range # 9 used by the Army during the 1940s. Additionally, it contains disturbed areas identified in the 1943 U.S. Army Topographic Engineering Center (TEC) Historical Photographic Analysis that can be characterized as disturbed areas caused by ordnance activities on and around the target area. The terrain (grasslands with gently rolling slopes) and geology (intermediate silicate/iron content) are consistent throughout the OU, and OE types anticipated are primarily 2.36-inch rockets and projectiles (37mm and 57mm). The criteria used in developing this OU was the correlation of the moving target range target location and the disturbed area identified in the 1943 Historical Photography Analysis.

- **OU-2:** This OU consists of the area identified as Mortar Range # 13 and potential target areas used by the Army during the 1940s. Additionally, it contains disturbed areas identified in the 1943 and 1947 TEC Historical Photographic Analysis that can be characterized as disturbances caused by mortar firing activities. The terrain (grasslands with gently rolling slopes) and geology (intermediate silicate/iron content) are consistent throughout the OU, and OE types anticipated are primarily mortars (60mm and 81mm). Portions of two Ground Ranges cross over OU-5 that could contribute projectiles (37mm, 57mm, and 75mm) to the potential OE types anticipated. The criteria used in developing this OU was to use the road (Kapaka Lane) that separates OU-2 from OU-4 as a geographical reference for field workers on the eastern side of OU-2. The western side of OU-2 was determined by the Area 1-A boundary and parcel boundaries closest to the OU-6 and OU-3 target features. Some overlapping of OE types may occur in OU-2 and -4 since definitive separation could not be achieved feasibly.

- **OU-3:** This OU consists of potential target areas for a Ground Range, and short drops (missed target) meant for Night Target # 1. Additionally, it contains multiple disturbed areas identified in the 1943, 1947, and 1953 TEC Historical Photographic Analysis that can be characterized as disturbed areas caused by mixed range activities for Bomb Night Target # 1 and target areas for the Ground Range overlapping the OU. The terrain (grasslands with gently rolling slopes) and geology (intermediate silicate/iron content) are consistent throughout the OU, and OE types anticipated are a mixture of aerial bombs (M38A2) and projectiles (37mm, 57mm, and 75mm).

- **OU-4:** This OU consists of target areas for Ground Ranges # 11 and #12, Mortar Range # 13, and two Ground Ranges used by the Army during the 1940s. Additionally, it contains disturbed areas identified in the 1943 and 1947 TEC Historical Photographic Analysis that can be characterized as disturbances caused by range activities on and around numerous target areas. The terrain (grasslands with gently rolling slopes) and geology (intermediate silicate/iron content) are consistent throughout the OU except in the most eastern portion of the OU. The eastern portion of the OU has a geology of quartz diorite and tonalite and terrain consisting of moderate levels of tree canopy and steep slopes that may require different geophysical methodologies to detect OE. OE types anticipated are primarily projectiles (37mm, 57mm, and 75mm) and mortars (60mm and 81mm). A practice M-1 land mine was recovered in this OU, and additional land mines may be located. The criteria used in developing this OU was to use the road (Kapaka Lane) that separates OU-2 from OU-4 as a geographical reference for field workers. Some overlapping of OE types may occur in OU-2 and -4 since definitive separation could not be achieved feasibly.

- **OU-5:** This OU consists of the area identified as Bomb Target # 1 used by the Air Force during the 1950s. Additionally, it contains disturbed areas identified in the 1953 TEC Historical Photographic Analysis that can be characterized as disturbed areas caused by bombing activities on and around the target area. The terrain (grasslands with gently rolling slopes) and geology (intermediate silicate/iron content) are consistent throughout the OU, and OE types anticipated are primarily aerial bombs (M38A2 Practice Bombs) or hazardous explosive components from bombs (spotting charges). The criteria used in developing this OU was the correlation of the bombing target location and the disturbed area identified in the 1953 historical photography analysis. Portions of the disturbed area associated with the bombing target extend into OU-1, which was propagated by using parcel boundaries as the ultimate boundary criteria.

- **OU-6:** This OU consists of the area identified as Bomb Night Target # 1 used by the Air Force during the 1950s. Additionally, it contains disturbed areas identified in the 1953 TEC Historical Photographic Analysis that can be characterized as disturbed areas caused by bombing activities on and around the target area. The terrain (grasslands with gently rolling slopes) and geology (intermediate silicate/iron content) are consistent throughout the OU, and OE types anticipated are primarily aerial bombs (M38A2 Practice Bombs) or hazardous explosive components from bombs (spotting charges). The criteria used in developing this OU was the correlation of the bombing target location and the disturbed area identified in the 1953 historical photography analysis.

- **OU-7:** This OU comprises the boundaries of Area 1-B.

3.7 DESCRIPTION OF ORDNANCE AND EXPLOSIVES SUSPECTED TO BE IN VOLUME 1 AREAS

The following paragraphs summarize the types of OE/UXO (and the purpose/function of each item) suspected to be in Area 1-A and Area 1-B based on information identified during previous surface clearances, prioritization site visit, historical records analysis, and the Volume 1 EE/CA field investigation. Table 3-2 lists the types of OE/UXO suspected in Area 1-A and Area 1-B followed by a brief description of the OE Item. For each of the OE/UXO items identified, an individual would have to perform some deliberate act to be exposed to OE risk. The type and sensitivity of OE affects the likelihood and severity of injury if OE functions when encountered by an individual. Descriptions of each listed OE item are provided. Further discussions on OE risk is provided in Chapter 4.0.

Table 3-2. Suspected UXO in Area 1-A and Area 1-B

OE Type
37mm HE projectile
57mm HE recoilless rifle projectile
60mm HE mortar
75mm HE projectile
81mm HE projectile
81mm white phosphorus projectile
155mm HE projectile
2.36-inch rocket
MK 76 practice bomb
M1 landmine
Smoke bombs
M38A1 practice bomb

HE = high explosive
mm = millimeter
OE = ordnance and explosives

37mm Projectile. This projectile contains an explosive filler (TNT), is designed to be deployed from land-based gun platforms, and projects high-velocity fragments in a 360-degree pattern. Fragments may project to a distance of up to 1,181 feet.

57mm Projectile. This projectile contains an explosive filler (Composition B) and is designed to project high velocity fragments in a 360-degree pattern. Fragments may project to a distance of up to 1,080 feet.

60mm Mortar. This mortar contains an explosive filler (Composition B) and is designed to project high velocity fragments in a 360-degree pattern. Fragments may project to a distance of up to 1,080 feet.

The illumination version of this mortar is designed to burn extremely hot and produce a bright light for night missions. Although OE with illumination fillers are less hazardous than high explosive or WP rounds, they can still be extremely dangerous to individuals handling them.

75mm Projectile. This projectile contains an explosive filler (AMATOL), is designed to be deployed from land-based gun platforms, and projects high velocity fragments in a 360-degree pattern. Fragments may project to a distance of up to 1,701 feet.

81mm Mortar. The HE 81mm mortar contains an explosive filler (Composition B) and is designed to project high velocity fragments in a 360-degree pattern. Fragments may project to a distance of up to 1,233 feet. The WP version of this mortar is designed to burn extremely hot and produce a thick cloud of white smoke. The burster tube, which detonates to open up the mortar and expose the WP to air, is not designed to produce high velocity fragments, but may produce some fragments for a short range. Unused or remaining WP may spontaneously ignite when exposed to air.

155mm Projectile. This projectile contains an explosive filler (Composition B), is designed to be deployed from land-based gun platforms, and projects high-velocity fragments in a 360-degree pattern. Fragments may project to a distance of up to 2,577 feet.

2.36-inch Rocket Warhead. The 2.36-inch rocket warhead contains 8 ounces of explosive filler (pentolite) and is designed to penetrate armored vehicles. Case fragments may project in a 360-degree pattern at a distance of up to approximately 809 feet.

M38A1 Practice Bomb. This practice bomb contains an approximate 4-pound spotting charge (black powder) situated in the base of the bomb. It is designed to fire on impact to provide a visual sign for pilots and spotters. It is not designed to produce high velocity fragments but may produce some fragments for a short range.

MK 76 Practice Bomb. This 25-pound practice bomb contains a spotting charge situated in an internal tube at the center of the bomb. It is designed to fire on impact to provide a visual sign for pilots and spotters and can project flame and smoke for approximately 50 feet from the base of the bomb. It is not designed to produce high-velocity fragments, but may produce some fragments or secondary fragments for a short range.

M1 Anti-Tank Mine. This mine can contain an explosive filler (TNT), is designed to be buried in the intended or expected path of armored vehicles or tanks, and projects a high-pressure shock wave upward into the tank or vehicle to cause damage or injuries. This mine is thin-cased, and is not designed to project high-velocity fragments; however, some fragments and secondary fragments (e.g., rocks) can be expected.

Smoke Bombs. Smoke bombs can contain incendiary or white phosphorus compounds. They are designed to fire at impact to provide a smoke screen to obscure troop movements. They are not designed to produce high-velocity fragments, but may produce some fragments or secondary fragments for a short distance. Incendiary or white phosphorus compounds can cause serious burns upon contact with the skin.

THIS PAGE INTENTIONALLY LEFT BLANK